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Morphometric Variation in Two Populations of the Cactus Mouse (*Peromyscus eremicus*) from Trans-Pecos Texas

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Abstract

External and cranial measurements of specimens of the cactus mouse (*Peromyscus eremicus*) from two localities in the Trans-Pecos region of Texas (Harte Ranch addition to Big Bend National Park; Big Bend Ranch State Park) were analyzed statistically to determine morphometric variation in mice from these two localities. Univariate and multivariate statistical analyses were performed on 50 specimens from each locality. Discriminant function analysis of cranial characteristics was used to classify individual specimens to each locality. Results suggest that there is minimal significant difference in mice from the two localities, but not enough to warrant recognition of geographic variation, and there are no significant morphological differences between sexes.

Key words: Big Bend National Park, Big Bend Ranch State Park, *Peromyscus eremicus*, univariate and multivariate statistics

Introduction

The cactus mouse, *Peromyscus eremicus* (Baird 1858), is a rather common rodent found in desert scrub habitats throughout the southwestern United States, from western Texas to southern California, and from northern and central Mexico to Baja California and some adjacent islands, both in the Pacific Ocean and the Sea of Cortez (Veal and Caire 1979; Hall 1981). In Texas, the cactus mouse is found from Val Verde County on the Edwards Plateau (Goetze 1998), to throughout most of the Trans-Pecos (Yancey 1997; Schmidly 2004). The preferred habitat is desert scrub, especially areas with rocky outcrops. Often the species can be taken in man-made structures (Schmidly 2004; Yancey et al. 2006).

The biology of the cactus mouse (*Peromyscus eremicus*) was summarized by Veal and Caire (1979). In their treatment, they stated that considerable variation exists among the 15 subspecies of *P. eremicus*. They cited the following selected external and cranial measurements in particular: total length, length of tail, length of hind foot, length of ear, greatest length of

skull, and zygomatic breadth. Dice (1939) also reported morphological differences amongst the sexes, with female *P. eremicus* significantly larger than males in the following measurements: body length, length of ear, length of mandible, and bullar width of skull. With this in mind, we undertook a study to examine geographical variation and sexual dimorphism of cactus mice from two areas of the Trans-Pecos in West Texas. The subspecies reported here is *P. eremicus eremicus* (Baird) (see Hall 1981; Manning and Jones 1998).

METHODS AND MATERIALS

The source areas for our specimens were: 1) the Harte Ranch addition to the northwestern part of Big Bend National Park (HR), Brewster County, Texas; and, 2) Big Bend Ranch State Park (BBRSP), Presidio County, Texas. A total of 50 adult specimens (25 males and 25 females) was selected from each locality for analysis. All of the specimens (most of which were collected by the authors) are deposited in the mammal collection of the Natural Science Research Laboratory at The Museum of Texas Tech University.

External measurements were taken from specimen labels, whereas cranial measurements were taken from museum material by one of the authors (RWM) using digital calipers. Standard external measurements included: total length (TL), length of tail vertebrae (TV), length of hind foot (HF), and length of ear pinnae (EAR). Cranial measurements included: greatest length of skull (GLS), zygomatic breadth (ZB), breadth of brain case (BBC), postorbital constriction (POC), depth of cranium (DC), length of rostrum (LR), breadth of rostrum (BR), length of maxillary toothrow (LMAX), breadth across upper first molars (BM1-M1), width of first upper molar (WUM1), mastoid breadth (MB), and length of mandible (LMAND).

Univariate and multivariate statistical analyses were preformed using S-plus software (1998) on a Dell computer. Our null hypothesis was that there is no significant difference between external and cranial measurements of cactus mice at two localities from Trans-Pecos Texas.

RESULTS

Results of univariate analyses of characters are presented, by locality, in Table 1 (external measurements) and Table 2 (cranial measurements). Results of multivariarte analysis of variance (MANOVA) for external characteristics suggest that there is a significant difference between sample localities ($p = 0.00035$) but there is no significant difference between sexes ($p = 0.47021$) or sex by locality ($p = 0.67538$). Results of multivariarte analysis of variance (MANOVA) for cranial characteristics suggest that there is a significant difference between sample localities ($p = 0.00005$), but there is no significant difference between sexes ($p = 0.46617$) or sex by locality ($p = 0.74785$).

Univariate tests (t-test) suggest that one external character, length of hind foot (HF), was significantly different between the two samples (see Table 1). Univariate tests suggest that three cranial characters, depth of braincase (DC), length of maxillary toothrow (LMAX), and length of mandibular toothrow (LMAND), were significantly different between the two samples (see Table 2).

Discriminant function analysis (DFA), using cranial characteristics, was used to classify individual specimens to either locality (or group). Multivariate t-test indicates a significant difference between groups. The analysis correctly classified 38 of 50 individuals (locality 1) and correctly classified 42 of 50 individuals (locality 2). Overall, 80% of the specimens were correctly classified using DFA. A Jack-knife DFA (a more robust test) correctly identified 71% of the specimens. Similar results, 76% correctly classified, were obtained on DFA using external features.

*Table 1. Descriptive statistics for external measurements of cactus mice from Harte Ranch (HR) and Big Bend Ranch State Park (BBRSP), Texas. Standard external measurements (in mm) included: total length (TL), length of tail vertebrae (TV), length of hind foot (HF), and length of ear pinnae (EAR). Sexes were combined because multivariate statistics between sexes were not significant. Numbers presented indicate arithmetic mean, one standard deviation, and sample size (*n*). NS = univariate non-significance,* p *= probability.*

	Harte Ranch	Big Bend Ranch State Park	univariate significance
TL	183.6, 7.5 (49)	183.5, 8.6 (49)	NS
TV	95.4, 6.1 (49)	95.8, 5.1 (49)	NS
HF	19.4, 0.8 (50)	20.0, 0.5 (50)	$p \leq 0.001$
EAR	18.1, 1.0 (50)	18.3, 0.7 (50)	NS

*Table 2. Descriptive statistics for cranial measurements (in mm) of cactus mice from Harte Ranch (*n *= 50) and Big Bend Ranch State Park (*n *= 50), Texas. Cranial measurements included: greatest length of skull (GLS), zygomatic breadth (ZB), breadth of brain case (BBC), postorbital constriction (POC), depth of cranium (DC), length of rostrum (LR), breadth of rostrum (BR), length of maxillary toothrow (LMAX), breadth across upper first molars (BM1-M1), width of first upper molar (WUM1), mastoid breadth (MB), and length of mandible (LMAND). Sexes were combined because multivariate statistics between sexes were not significant. Numbers presented indicate arithmetic mean and one standard deviation. NS = univariate non-significance,* p *= probability.*

	Harte Ranch	Big Bend Ranch State Park	univariate significance
GLS	25.0, 0.47	24.9, 0.71	NS
ZB	12.6, 0.35	12.5, 0.35	NS
BBC	11.7, 0.22	11.6, 0.26	NS
POC	3.95, 0.11	3.97, 0.11	NS
DC	8.99, 0.21	8.81, 0.22	$p \leq 0.001$
LR	9.04, 0.27	9.08, 0.38	NS
BR	3.70, 0.31	3.62, 0.31	NS
LMAX	3.57, 0.10	3.65, 0.11	$p \leq 0.001$
BM1-M1	4.69, 0.10	4.67, 0.14	NS
WUM1	1.09, 0.03	1.09, 0.03	NS
MB	10.9, 0.28	10.9, 0.29	NS
LMAND	3.59, 0.09	3.66, 0.12	$p \leq 0.001$

DISCUSSION, SUMMARY, AND CONCLUSIONS

Although statistical analysis suggests there are significant univariate differences between our site-specific samples in one external character (length of hind foot, HR sample, 19.4 mm versus BBRSP sample, 20.00 mm) and three cranial characters (depth of brain case, HR, 8.99 mm versus BBRSP, 8.81mm; length of maxillary toothrow, HR, 3.57 mm versus BBRSP, 3.65 mm; and length of mandibular toothrow, HR, 3.59 mm versus BBRSP, 3.66 mm), we do not feel that these are strong enough differences to support the hypothesis that there is marked dimorphism between specimens from our two localities. Cactus mice from BBRSP have slightly longer maxillary and mandibular toothrows and slightly deeper crania when compared

to cactus mice from HR. Perhaps this is the result of selection pressures for a more powerful bite to process different, tougher, or larger seeds or other foods.

Dice (1939) reported morphological differences between the sexes of *P. eremicus*, with females being significantly larger than males in the following characters: body length (which we reject), length of ear (which we reject), length of mandible (which we support), and bullar width of skull (which we reject). We do not feel this is a strong enough difference to support the hypothesis that there is marked sexual dimorphism between males and females in these samples. Results of our multivariate tests further indicate that there is no statistically significant difference between sexes at either locality. There is no demonstrable significant sexual dimorphism between male and female cactus mice (*P. eremicus eremicus*) from our two Trans-Pecos Texas localities.

Other subspecies of cactus mice, especially some of the eight insular taxa of *P. eremicus* (*tiburonensis*, *cedrosensis*, *avius*, *insulicola*, *polypolius*, *cinereus*, *collatus*, and *pullus*), are worthy of morphological investigation.

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